Report on an Evaluation of
TILE DRAINS LAID WITH ORGANIC BLINDING MATERIALS

Skagit S.C.D., Washington

Prepared by
R. H. Brownscombe, E. W. Cowley,
and R. E. Tuttle

May, 1959

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

OUR SOIL ★ OUR STRENGTH

USDA SCS PORTLAND, OREG. 1959 M-2542

57996

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TILE DRAINS LAID WITH ORGANIC BLINDING MATERIALS 1/
Skagit SCD, Washington

SUMMARY

Organic blinding materials for drain tile were examined by excavating tile lines six to eleven years old in Skagit County, Washington. Observations were made also of the tile joints and condition of the tile lines. Little or no mineral soil was found in the blinding material or in the tile lines, except in the less stable subsoils such as those associated with Puget fine sandy loam and Puyallup silt loam. Straw was slightly to moderately deteriorated and varied in thickness from 1/16 to 3/4 inch at most sites. Wood chips were but little decayed after 9 years. Concrete tile showed considerable deterioration after 6 to 11 years where pH was 4.5 to 6.5 at tile depth. Tile joints averaged 1/16 to 1/8 inch in width around the circumference. A deposit of muck, probably highly organic, was found in all lines submerged all or part of the year. Improved outlets are needed for proper functioning of the tile lines, and they may prevent the formation of the tile deposit. This evaluation of tile lines is supplementary to proposed evaluations of tile drawdown in the same area.

SCOPE OF THE EVALUATION

In western Washington and Oregon it is a common practice to place an organic material such as straw, wood chips, or sawdust over the newly laid drain tile before backfilling. This material, though sometimes called a filter, probably should be referred to as a blinding material, at least until its function is better understood and controlled.

The purpose of this evaluation in western Washington was to determine the condition and effectiveness of the organic material by means of visual inspection and limited laboratory analysis of soil samples. This information was needed to determine the need for and the direction of further work, and to improve present Soil Conservation Service design standards to the extent that firm conclusions may be made.

Details of the field work were planned by Anton Harms, Roy Tuttle, E. W. Cowley, and R. H. Brownscombe for the low-water-table season of 1958. John Sutton, Drainage Engineer, Washington, D. C., recommended the evaluation in his report to C. J. Francis dated September 10, 1956. As pointed out in Cowley's report of September 10, 1957 to P. C. McGrew, this field study is supplementary to a proposed evaluation of tile drawdown, spacing and depth in the same area.

1/ By R. H. Brownscombe, Drainage Engineer, E&WP Unit, Portland, Oregon; E. W. Cowley, State Conservation Engineer, Spokane, Washington; and R. E. Tuttle, Area Engineer, Seattle, Washington.

The field conditions observed and reported on herein included:

1. Evidence of soil movement into organic material and into tile.
2. Position of the organic blinding material with respect to the tile.
3. State of decay of the organic material.
4. Alignment of tile lines and displacement at joints.
5. Backfill condition.
6. Tile joints - space, irregularities, material in the joint.
7. Deterioration of the tile, by appearance.
8. Outlet condition.
9. Soil mechanical analysis and plasticity.
10. Soil acidity.

SITE DESCRIPTION

Eight tile lines in Skagit Soil Conservation District were inspected by excavating to expose the tile at 1 to 4 locations on each line. Altogether, 18 excavations were made on 6 farms north and west of Mt. Vernon.

Soils included those most commonly tile drained in Skagit County: Snohomish silt loam, Sumas silt loam, Puget silt loam, Puget fine sandy loam, and Puyallup silt loam. The Snohomish and Sumas series include soils having layers of peat. The pH, estimated using a field kit of hydrogen ion indicators and later checked in the laboratory, varied from 4.5 to 6.5 at tile depth.

About 39,000 acres in Skagit County are Puget silt loam or Sumas silt loam. Puget and Sumas silty clay loams occupy about 11,000 acres. These two soils make up the major part of mineral soils needing improved drainage. Organic soils are the Snohomish silt loam, 2100 acres, and other organic soils covering an additional 2600 acres. Puget fine sandy loam makes up less than 3000 acres. Although there is a large acreage of the Puyallup series, it does not ordinarily require subsurface drainage.

Organic blinding material was straw at all of the sites but one. Wood chips were used on part of one tile line on the J. A. Knutzen farm. At the Arnold Wold farm, no remaining evidence of organic material could be seen at any of the three sites, although the owner stated that straw had been used. Where straw was found, it was judged that it was placed in a loose layer over the newly laid tile, not always the full width of the trench, and in varying thickness from very little to as much as one foot or more loose depth.

Age of the tile varied from 6 to 11 years. One 22 or 23 year old, hand-laid clay tile was excavated on the Wold farm. It was not known what organic material, if any, had been placed in the trench--none was evident.

Clay tile was used on 2 of the 6 farms; concrete on the others.

Cropping histories included the following rotations: Potatoes-oats-peas; potatoes-winter rye; peas-oats-peas; irrigated pasture of grass-legumes; grass pasture-peas. Moisture was unusually low (except in the irrigated pasture) due to the relatively long dry period preceding the observations.

All tile (except the 22-23 year old line) was laid behind a trenching machine; some of it, at least, by the use of a tile hook.

On 3 of the farms, tile outlets were submerged, even at this dry period of the year. The land is low. Mud flats outside the tide gates are so high and so wide that the water elevation at the gates is relatively high and responds only to the upper part of the ocean tide cycle. Winter flood water, which at times covers the land in the vicinity of these farms, may be drained off more or less effectively through the tide gates, but subsurface drain effluent is not. Consequently, the tile outlets in part of the area are completely submerged all or most of the year, and water is ponded the full length of some tile lines.

Climatically, the Skagit Flat area is typical of the mild and humid belt west of the Cascade Mountains. Annual precipitation is usually 30 to 40 inches.

PROCEDURE

Individual sites for tile evaluation were selected to be typical of the soil, blinding material, and tile construction in Skagit County.

Tile lines were located from the farm tile map, using a tile probe or auger. The tile line number and the distance of the excavation from the outlet end were noted and recorded.

A small backhoe was used for excavation (Photograph No. 1). First, a trench was dug beside the tile line and about 2 feet deeper. Then, the earth above the tile was removed so that 4 to 6 lengths of tile were uncovered on the edge of an earth shelf, convenient for inspection.

Hand shovels were used to complete the excavation and to shave off one or both ends of the trench. This permitted inspection of the backfill material which at all sites could be distinguished from the undisturbed soil profile. (Photograph No. 2)

The blinding material was inspected for kind, condition, thickness, position, and evidence of infiltrated soil particles. At the trench end, a tile length was removed and the organic material was cut through so as to observe a cross section of the tile and surrounding materials.

The tile was inspected for lateral displacement (shifting or improper laying), and for condition of the joints. Joint space was noted, as

well as material in the joint between the tile. General appearance of the tile was observed, and note made of visual defects.

The opened tile line was inspected for silting. An engineering level was used to determine the tile depth and grade to the outlet. Alignment was noted where light conditions permitted. Outlet condition was observed as open, submerged all year, or submerged part of the year.

Soil samples were taken at representative sites for determination of the mechanical analysis grading curve and the plasticity. The pH was estimated at several sites, using samples of the soil profile and backfill. Samples of material found inside the tile were taken after it was visually inspected.

Tile removed from the line was inspected for deterioration. Concrete tile was scraped or "picked" by hand, using a large knife, as a measure of the depth of deterioration at various points on the circumference.

Some tile was broken to observe deterioration and to get a rough measure of strength.

Photographs were taken at representative sites to show soil profile, backfill, filter material, tile in place, deposits in tile, and general views of the work.

Broken tile were replaced and the excavations backfilled before the crew left the farm.

RESULTS OF THE OBSERVATIONS

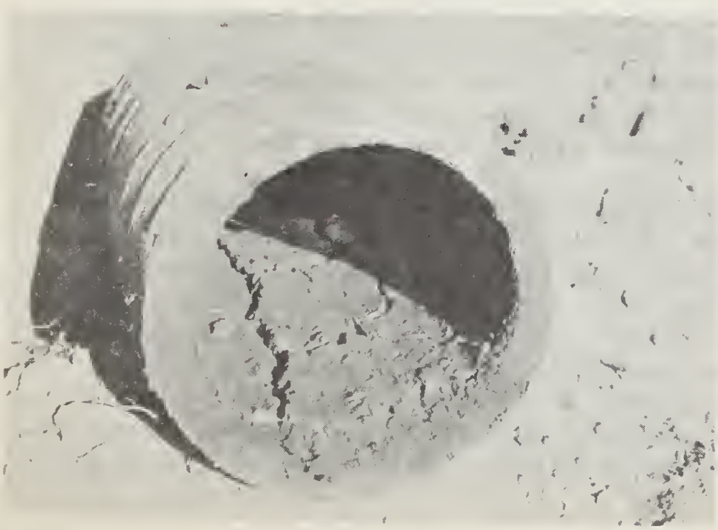
1. Soil Movement into Organic Material and Tile Lines

There was little or no visible evidence that mineral soil particles had moved into or through the organic blinding material. It is not known whether the muck found in the tile originates wholly within the tile or whether it may consist partly or wholly of particles transported from the soil.

At the Wold farm, one tile line was constructed through Puget fine sandy loam. The soil at tile depth along portions of the tile line was fine sandy loam and fine sand. There was no visible indication that straw or other organic material had been placed on this line. The tile was partially filled with silt and sand at the outlet, which is submerged part of the year. Forty feet up the tile line from the outlet, silt was 3/4" deep. Farther up the line, only a trace of silt was found except at one point where a chipped tile admitted sand through a 3/4" hole near the top of the tile. Below this defect, silt was 1-1/2" deep for a distance of at least several feet. A 22-23 year old clay tile line was dug up on this farm, about 30 feet below a blowout where ponded irrigation water had carried soil into the line. Here silt was about 1-1/2" deep in the tile.

1. Tile probe and backhoe used for excavating tile inspection pit, Skagit Co., Washington.

2. Examining tile line, filter material, and joint spacing.



3. Deposit of organic muck in tile, showing shrinkage cracks.

Although there seemed to be little or no mineral soil deposited in most of the tile, a reddish or black muck was found in those tile which are submerged all or much of the year. This appeared to be an organic material, slimy when wet, with low dry-weight and high shrinkage (Photograph No. 3). There may be some mineral soil particles in this material, but it was not evident by visual inspection or feel. The deposit was principally on the bottom of the tile, inside, but at one site the muck was about 1/4 inch thick around the whole inside area of the tile. It was considerably thicker just inside each joint, forming a projecting ridge about 1/2 inch wide inside the tile. The same material was found between the tile at the joints.

2. Position of Blinding Material

Straw placed on the tile generally formed a mat which "draped" over the tile and extended 6 to 9 inches out on each side of the tile. This mat was pressed against the trench bottom except within 2 to 4 inches of the tile on each side, where it arched across the gap under the tile sides. This left an opening or a strip of loose, uncompacted straw on each side of the tile which remained at least 6 to 11 years. At the top of the tile, the straw was compressed to a thin mat from 1/8 to 1-1/2 inches thick.

One tile line in the group inspected was constructed with wood chips as blinding material. The chips were small and might be classed as sawdust. Very little of the chips remained on the top of the tile after backfilling--the soil appeared to be directly in contact with the upper half of the tile. The layer of chips on each side extended from the lower portion of the tile circumference, nearly to the sides of the trench. No wood chips were under the lowest 1/4 of the tile circumference.

3. Deterioration of Organic Blinding

The straw was slightly to moderately deteriorated. There appeared to have been little mixing of earth with the straw at the time of construction. Where deterioration was classified as slight, individual straws were nearly all intact, though some were weak and soft, and bunches of straw could be pulled out and handled much as with fresh straw. Moderate deterioration indicates that a substantial part of the straw is no longer intact and is mixed with soil particles. Some straw was tightly compressed on top of the tile.

At the one site where wood chips were found, they were only slightly decayed after 9 years in the ground. When uncovered, they were loose and porous. It appeared that they would function adequately to improve the flow into the tile line. As placed, however, this material would not be an effective filter to prevent silting of the tile line because there was no filter material on the upper or lower sides of the tile. The soil at this site was Snohomish silt loam, and as pointed out under item 1 above, this soil appears to be quite stable. These results, therefore, do not indicate the effectiveness

of the wood chips in less stable soils such as Puget fine sandy loam or other soils having sandy and silty subsoils.

4. Alignment of Tile

None of the tile at any of the inspection sites had settled out of place to cause misalignment at joints or sags in the tile line. Even on the peat subsoil, no appreciable settlement was evident from inspection or from the engineering levels run at each of the three excavations.

5. Backfill

At all excavations the backfill material could be distinguished from the original soil profile, and the trench outline was more or less evident. Surface soil was mixed with soil from lower layers in all the backfills, probably as a result of the trenching and backfilling operations. It was judged that the backfill material at the time of excavation was at least as permeable in a vertical direction as the original soil.

6. Tile Joints

Concrete tile had somewhat closer joints than the clay tile, generally. Except for the tile lines which are submerged all or part of the year, the spaces between both concrete and clay tile joints were open and adequate to permit entry of water. Even where the concrete tile were touching, openings were observed and these showed evidence of water entry.

Submerged tile lines contained a deposit of organic muck, as described above. Joints between these submerged tile were partially filled with the same organic material or other sediment. This deposit was found between the tile regardless of the space between the tile. In some cases, it had closed the openings on the lower half of the tile. The deposit on the inside wall of the tile was thickest close to the joint; in fact, there was a ring of this thicker deposit at each joint of submerged tile. No joints were found, however, which did not indicate some openings for water around the upper half of the tile. About 5 or 6 joints were inspected at each site, representing roughly 2% of the total number of tile joints in these lines.

7. Tile Deterioration

All of the concrete tile showed some degree of deterioration. The pH varied from about 4.5 to 6.5 at tile depth. From 1/16 to 3/8 inch of concrete could be scraped or picked off the outside surface of the tile with a large knife. Without exception, the bottom 1/4 or 1/5 of the tile was not so deteriorated. This portion of each tile was in contact with the original soil at the trench bottom; or, in some cases, this portion was not touching either soil or filter because of the groove still remaining from the trenching machine shoe.

Some concrete tile was softened to a depth of 1/16 to 1/8 inch on the inside also, but the inside generally was less affected than the outside.

8. Outlet Conditions

Outlets were poor at 5 out of 6 farms, due to high water level in the outlet ditch. Consequently, the tile lines are only partly effective in lowering the water table.

The muck deposit found in some of the tile lines was associated with the lack of outlet, as described in items 1 and 6 above.

9. Results of Materials Testing

The pH of samples submitted to the Materials Testing Section closely checked the field measurement of pH. Soil at tile depth ranged from pH 4.4 to pH 6.4, with an average of 5.4. Effect of acidity on concrete tile is discussed in item 7 preceding.

Plasticity was estimated for all samples, using the field identification tests described in Portland E&WP Unit Technical Memorandum, Soil Mechanics Series, No. 2. Of the 9 samples of soil tested, 3 were classified low plasticity and 6 non plastic. The Sumas silt loam and Puget silt loam samples were low plasticity.

Mechanical analyses for six of the 11 samples are shown in Figures 3 to 8.

All samples from the J. A. Knutzen farm, including the sample of the tile deposit, were high in organic material content. For this reason, the grading curve of these samples may not truly represent the soil particle gradation. This soil is mapped as Snohomish silt loam. Grading curves for these organic samples plot considerably coarser than the others, on the average.

Puget fine sandy loam and Puyallup silt loam, both from the Wold farm, were rather poorly graded and appeared to have considerable piping hazard. A sample was taken of Puyallup silt loam subsoil near a section of tile line which had "silted up" partially, and another of the deposit within the tile. The two grading curves appear to indicate that the particle size range constituting the greater part of the material carried into the tile was from 0.02 to 0.05 mm, which is silt by the USDA classification. The two samples on this farm had the lowest uniformity coefficients of any of the samples, and were therefore the most poorly graded. They had a high percentage of silt and fine sand. Both are non plastic and appear to be low in organic material.

DISCUSSION OF RESULTS

Visual inspection of the tile and straw blinding material indicated little or no movement of mineral soil into or through the straw. This may be due to the inherent stability of the soil rather than to the excellence of the organic blinding material acting as a filter. On the other hand, such a "filter" probably serves a useful purpose in all of these soils, in preventing loose soil particles in the newly placed backfill from entering the tile line immediately after construction. In all the submerged lines, however, there was a deposit of "muck" which appeared to be largely organic. Further examination of the muck is needed to determine its cause and origin, and whether better outlets will eliminate the deposit.

At two of the excavation sites, silt and fine sand had been carried into the tile lines at certain points. It was judged that the subsoils at these two locations were less stable and lower in organic material content than at the other sites. No straw or organic blinding material was evident. These two lines on the Wold farm show the need for good filters and careful construction in the fine sandy loam and fine sand subsoils. It is reported that the Sumas silt loam is in many places underlain with fine sand, at depths reached by the deeper tile lines.

All of the soils were either non plastic or of low plasticity.

Most of the straw and all of the wood chip material was at the sides of the tile. Openings remained under the straw mat due to bridging across at the sides. These channels could be a hazard if they continued for a considerable distance, by causing erosion and subsequent displacement of the tile.

Both straw and wood chips may facilitate the entry of water by providing a porous medium near to and connecting with the tile joint openings. It was observed, however, that the straw mat over some tile was compressed tightly against the tile so that this effect might be reduced or eliminated. Straw 11 years old was moderately decayed but judged still fairly effective in improving flow into the tile. Straw 6 years old was in general less decayed and nearly as effective as when first placed. It might be expected, under these conditions, that straw blinding material would be severely decayed after about 15 years. Wood chips were only slightly decayed after 11 years in the ground. If the tile had good outlets, the rate of deterioration might be significantly faster than observed here.

Tile lines were straight, with no evident displacement of individual tile lengths or settlement of the line, even in peat subsoils.

Backfill consisted of mixed top and subsoil and was clearly discernible in the wall of the excavation.

Tile joints varied in spacing from less than 1/16 inch to as much as 1/4 inch, average around the circumference. Most spaces averaged 1/16 to 1/8 inch.

All concrete tile was deteriorated to the extent that 1/16 to 3/8 inch of the softened outer layer was discolored and could be scraped off with a knife. Average thickness of this layer was 1/8 inch. Clay tile was unaffected. The pH was from 4.4 to 6.4 in the soil surrounding the tile. The pH of the blinding material was not determined, and may be low even in soils near neutral.

RECOMMENDATIONS

1. Make the evaluation of tile depth and spacing in the Skagit SCD, as described by Earl Cowley in his letter of September 10, 1957 to P. C. McGrew: "The evaluation of tile spacing and depth can be accomplished by close observation of the ground water surface between tile lines of various spacing and depth located in different soils. Observation wells or piezometer installations would be necessary for this work. Hydraulic conductivity of the soils being drained should also be measured. This work can be done by local personnel using methods described in a training guide entitled, 'Drainage Investigations as a Basis for Design'. This guide was issued by the State Office - March 23, 1956."

   This information is needed to develop local technical guides for drain depth and spacing. Tile lines selected for drawdown measurements should not be submerged.

2. Analyze the organic muck observed within the submerged tile lines to determine how much, if any, mineral soil is present and the nature of the organic material. This may require microscopic examination and ignition tests.

3. Make a few selected field examinations to determine whether such deposit will form in tile which has an adequate outlet, in the same soils as those in this study.

4. In subsoils of sand, sandy loam or other unstable soils which have a relatively high piping hazard, use the following construction to prevent silting:

   Butt the tile together so that they touch after placing. Use care in selecting and laying tile to avoid tile with irregular or chipped ends. Where joint space does not exceed 1/16 inch, tar-saturated building paper or fiber glass mats may be used to prevent fine sand and silt from entering the tile. The upper two-thirds of the circumference should be covered and the tile blinded with topsoil, straw or sawdust. Where this protection will not be provided, and in any case where the joint space will exceed 1/16 inch, use a sand-gravel filter designed in accordance with the mechanical analysis of the soil in which the tile will be laid (Form WS-63).

5. Where straw is used as a blinding material, place the straw on and around the tile after the tile is placed in the trench. Sufficient straw should be used to form a continuous layer at least three inches thick immediately after compression by the backfill. Place straw so that no continuous opening remains at the sides of the tile.

6. Wood chips or sawdust backfill material should be placed after the tile is laid so as to form a continuous layer on top of as well as at the sides of the tile. Thickness of the wood chips

or sawdust around the tile should be no less than 6 inches in the loose condition.

7. Do not use concrete tile with organic blinding material or in organic soil or soil layers.

   Do not use Standard or Extra Quality concrete tile in mineral soils having pH less than 6.0 at tile depth.

   Do not use Special Quality concrete tile in soils having pH less than 5.5 at tile depth.

   All concrete tile should meet the requirements of ASTM Specification C412-58T, and all clay tile should meet the requirements of ASTM Specification C4-55.

   There is a considerable variation in pH from place to place and within the profile in a vertical direction. It may not be practical to predict closely the pH which will actually exist at tile depth under these conditions. It is recommended that clay tile be used for all tile drains in Skagit Flats except where pH measurements representative of the most acid portions of the soil to tile depth, indicate the suitability of concrete tile by the criteria above.

8. Study the physical and economic feasibility of low-lift pumping of tile drain effluent in this area. This may be the only practical solution to the problem of the organic tile deposits described in this report. Pumping may also be necessary and economically feasible for full crop production. It is possible that the tile deposits will increase and eventually plug the submerged tile lines unless outlets are improved.

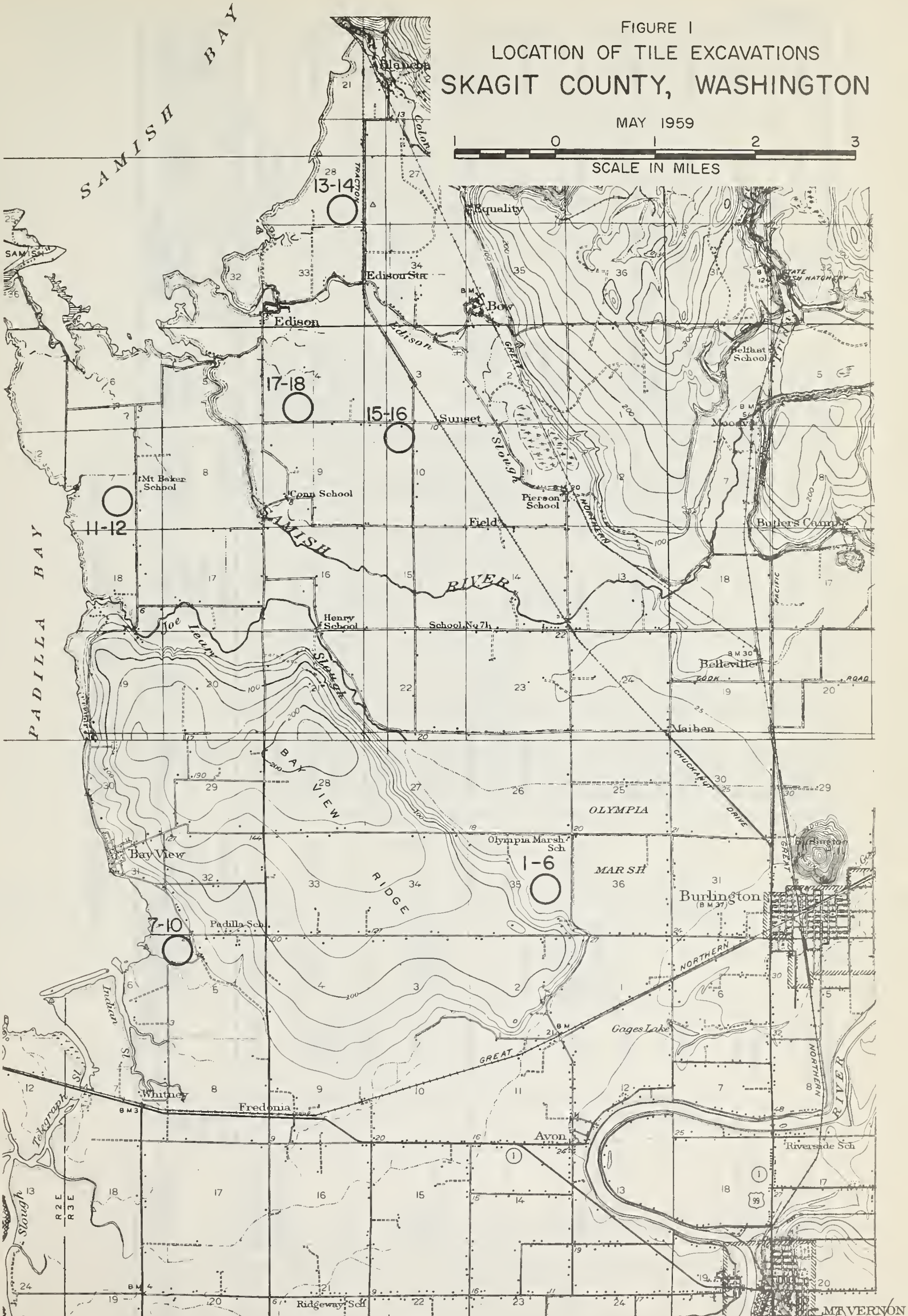


FIGURE 1
LOCATION OF TILE EXCAVATIONS
SKAGIT COUNTY, WASHINGTON
MAY 1959

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

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FIGURE 2

EVALUATION OF DRAIN TILE AND ORGANIC BLINDING MATERIAL
Skagit County, Washington

SITE			ORGANIC MATERIAL			TILE				SILTATION			
NO.	SOIL	AGE OF LINE yrs.	KIND	DETERIORATION	THICKNESS ON TOP OF TILE inches	KIND AND SIZE	EST. pH	TILE DETERIORATION inches	JOINT SPACE inches	APPEARANCE	DEPTH OF SILTATION inches	TILE GRADE ft./ft.	OUTLET CONDITION
1-4	Snohomish silt loam	11	Straw	Moderate	3/16-3/8	Concrete 6-inch	5.5 to 6.5	1/16-1/8	1/16+	Red organic muck	1	0.00065 0.0012	Subm'd.
5-6		11	Wood Chips	Slight	None	Concrete 6-inch	5.0 to 5.5	1/4-3/8	1/16	Red organic muck	1/2	--	Subm'd.
11		6	Straw	--	1	Concrete 6-inch	4.5 to 5.0	Slight to 1/8	1/8 to 1/4	Red organic muck	1/2; also top, sides	0.00116	Subm'd.
7-9	Sumas silt loam	8	Straw	Slight to Moderate	1/16-3/4	Clay 6-inch	4.9	None	1/8 to 1/4	--	None	0.0006	Good
13		7	Straw	--	1/2-1 1/2	Concrete 6-inch	5.0 to 5.5	--	1/16 to 3/16	Red & blk. org. muck	5/8	0.0008	Subm'd.
18		7	Straw	Slight	1	Concrete 6-inch	--	1/16 to 1/8	1/16+	Red. brn. org. muck	2	--	Subm'd.
8-10	Puget silt loam	8	Straw	Slight to Moderate	1/2-3/4	Clay 4 & 6"	--	None	1/8 to 3/8	--	None	0.0006	Good
12		6	Straw	--	1	Concrete 6-inch	4.4	Slight to 1/8+	1/8 to 1/4	Red organic muck	1/2; also top, sides	0.00116	Subm'd.
14		7	Straw	--	1/2	Concrete 6-inch	4.5 to 5.1	--	1/16 to 3/16	Red & blk. org. muck	5/8	0.0008	Subm'd.
16	Puget fine sandy loam	9	None Evident	--	--	Clay 6-inch	6.4	None	1/16+	V. fine sand	Trace	0.0035	Good
15	Puyallup silt loam	9	None Evident	--	--	Clay 6-inch	6.4	None	1/16+	V. fine sand	3/4 to Trace	0.0015	Subm'd.

MATERIALS TESTING SECTION REPORT	EWP-5 (10-20-56) Portland, Oregon	SOIL CLASSIFICATION

PROJECT	LOCATION
Tile Drain Evaluation	Skagit County, Washington — J. A. Knutzen

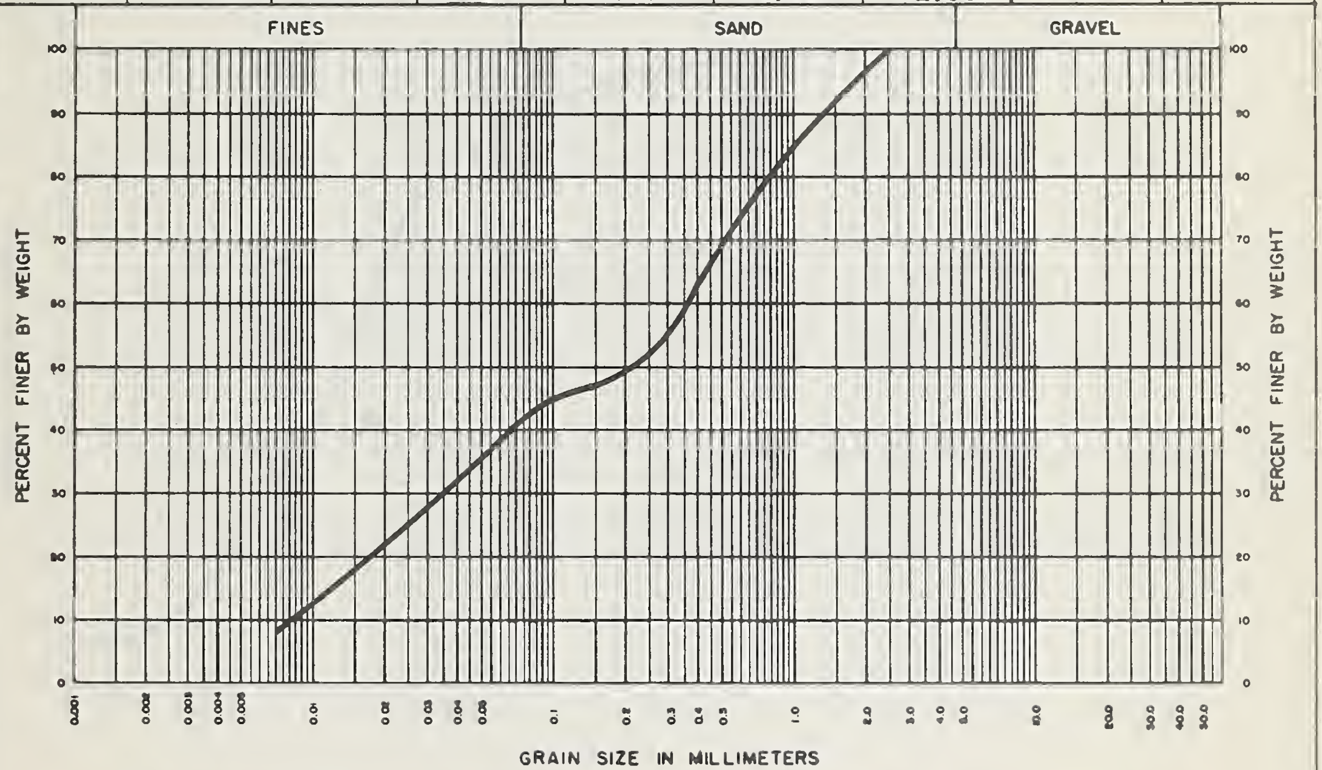
FIELD SAMPLE No.	TYPE of SAMPLE	ORIGIN
5	Bag	SOIL AT TILE DEPTH — Farm site 3, Tile line H, 10 + 60

PROPOSED USE	TESTING SECTION SAMPLE No.	SUBMITTED BY
Tile drain evaluation	590221	Tuttle

1: SYMBOL	2: DESCRIPTION
	Dark brown organic silty sand. Snohomish silt loam.

3: GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c
0.0081	0.012	0.035	0.21	0.35	1.00	2.50	--	--



4: SPECIFIC GRAVITY	5: ATTERBERG LIMITS						6: TOTAL SALTS	7: UNDISTURBED CONDITION	
	UNDISTURBED		AIR DRY		OVEN DRY			MOISTURE	UNIT WEIGHT
G	LL	PI	LL	PI	LL	PI			
2.26	--	--	--	--	--	--	-- %	-- %	-- lb/ft³

8: REMARKS

pH = 5.7
Non plastic (indicated by field identification test).
Grading curve may be in error due to high content of organic material.

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING and WATERSHED PLANNING UNIT
PORTLAND, OREGON

SIGNATURE	
J C Stevenson	
TITLE	DATE
Civil Engineer	12/19/58

MATERIALS TESTING SECTION REPORT	EWP- 5 (10-20-56) Portland, Oregon	SOIL CLASSIFICATION

PROJECT	LOCATION
Tile Drain Evaluation	Skagit County, Washington Jim Hulbert

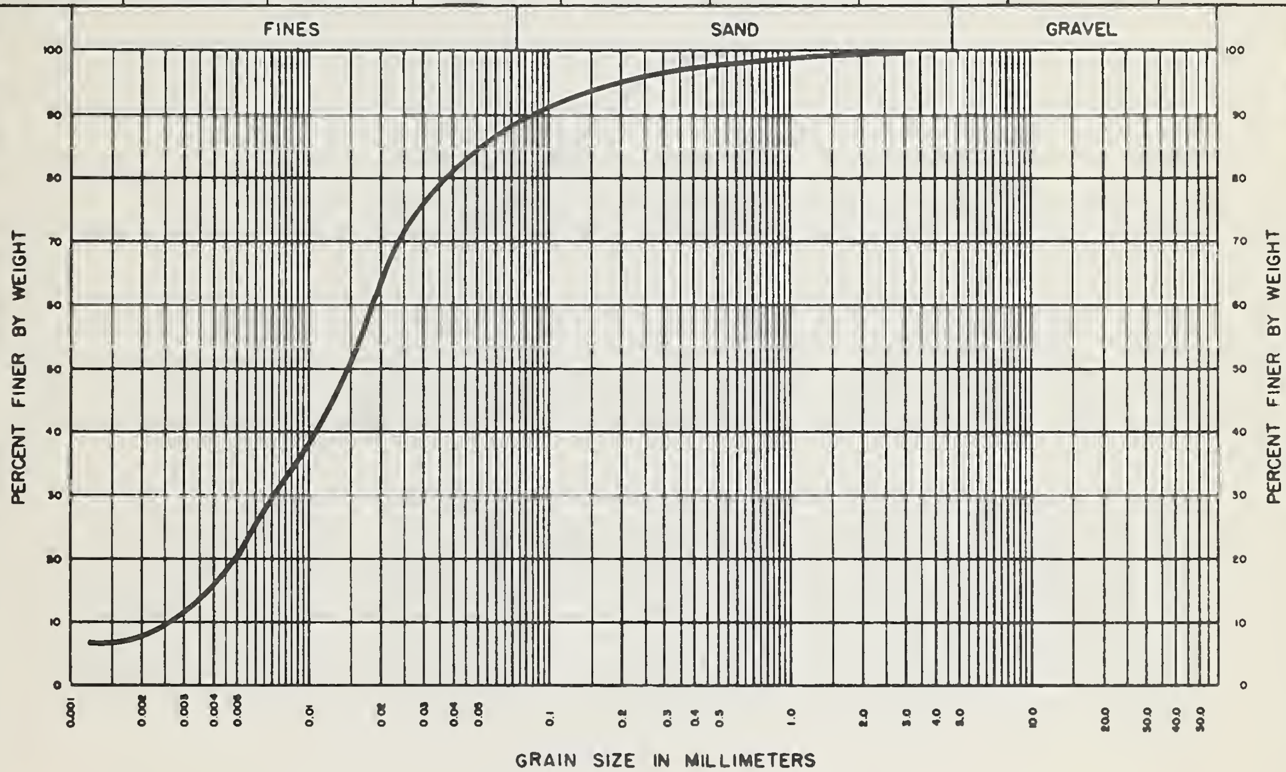
FIELD SAMPLE No.	TYPE of SAMPLE	ORIGIN
9	Bag	BACKFILL near tile. Farm site 1 0 + 60 Tile line A

PROPOSED USE	TESTING SECTION SAMPLE No.	SUBMITTED BY
Tile drain evaluation	590222	Tuttle

1: SYMBOL	2: DESCRIPTION
	Light gray silt Sumas silt loam

3: GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c
0.0025	0.0040	0.0070	0.014	0.018	0.055	2.70	--	--



4: SPECIFIC GRAVITY	5: ATTERBERG LIMITS						6: TOTAL SALTS	7: UNDISTURBED CONDITION	
	UNDISTURBED		AIR DRY		OVEN DRY			MOISTURE	UNIT WEIGHT
G	LL	PI	LL	PI	LL	PI			
--	--	--	--	--	--	--	-- %	-- %	-- lb/ft³

8: REMARKS

pH = 4.9

Low plasticity (indicated by field identification test).

U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING and WATERSHED PLANNING UNIT PORTLAND, OREGON	SIGNATURE JC Stevenson	
	TITLE Civil Engineer	DATE 12/19/58

MATERIALS TESTING SECTION REPORT	EWP- 5 (10-20-56) Portland, Oregon	SOIL CLASSIFICATION

PROJECT	LOCATION
Tile Drain Evaluation	Skagit County, Washington Einer Knutzen (Hanney)

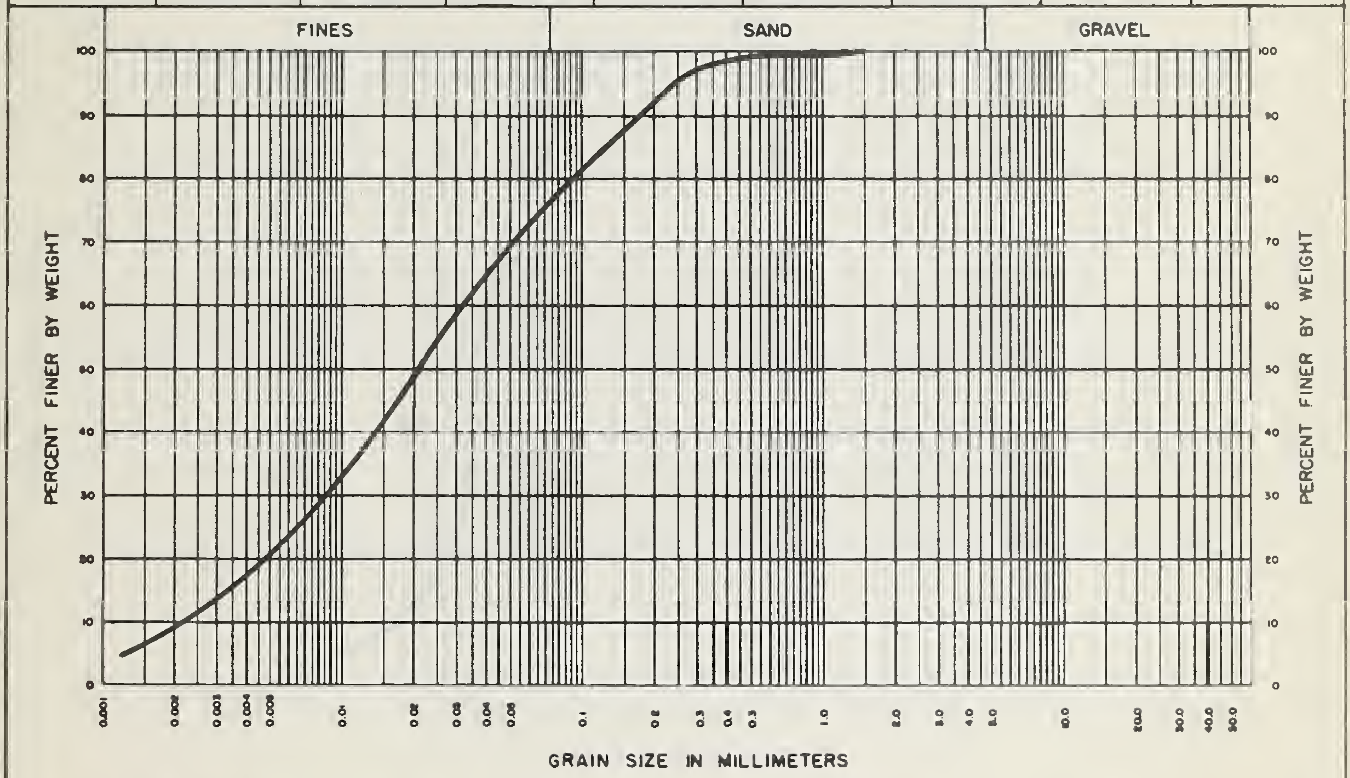
FIELD SAMPLE No.	TYPE of SAMPLE	ORIGIN
11	Bag	SOIL AT TILE DEPTH Farm site 2 Tile line D 3 + 70

PROPOSED USE	TESTING SECTION SAMPLE No.	SUBMITTED BY
Tile drain evaluation	590224	Tuttle

1: SYMBOL	2: DESCRIPTION
	Gray brown sandy silt. Puget silt loam

3: GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c
0.0022	0.0034	0.009	0.021	0.031	0.13	2.00	--	--



4: SPECIFIC GRAVITY	5: ATTERBERG LIMITS						6: TOTAL SALTS	7: UNDISTURBED CONDITION	
	UNDISTURBED		AIR DRY		OVEN DRY			MOISTURE	UNIT WEIGHT
G 2.80	LL --	PI --	LL --	PI --	LL --	PI --	-- %	-- %	-- lb/ft³

8: REMARKS

pH = 4.5

Low plasticity (indicated by field identification test).

U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING and WATERSHED PLANNING UNIT PORTLAND, OREGON	SIGNATURE: JC Stevenson	
	TITLE: Civil Engineer	DATE: 12/19/58

MATERIALS TESTING SECTION REPORT	EWP-5 (10-20-56) Portland, Oregon	SOIL CLASSIFICATION

PROJECT	LOCATION
Tile Drain Evaluation	Skagit County, Washington Arnold Wold

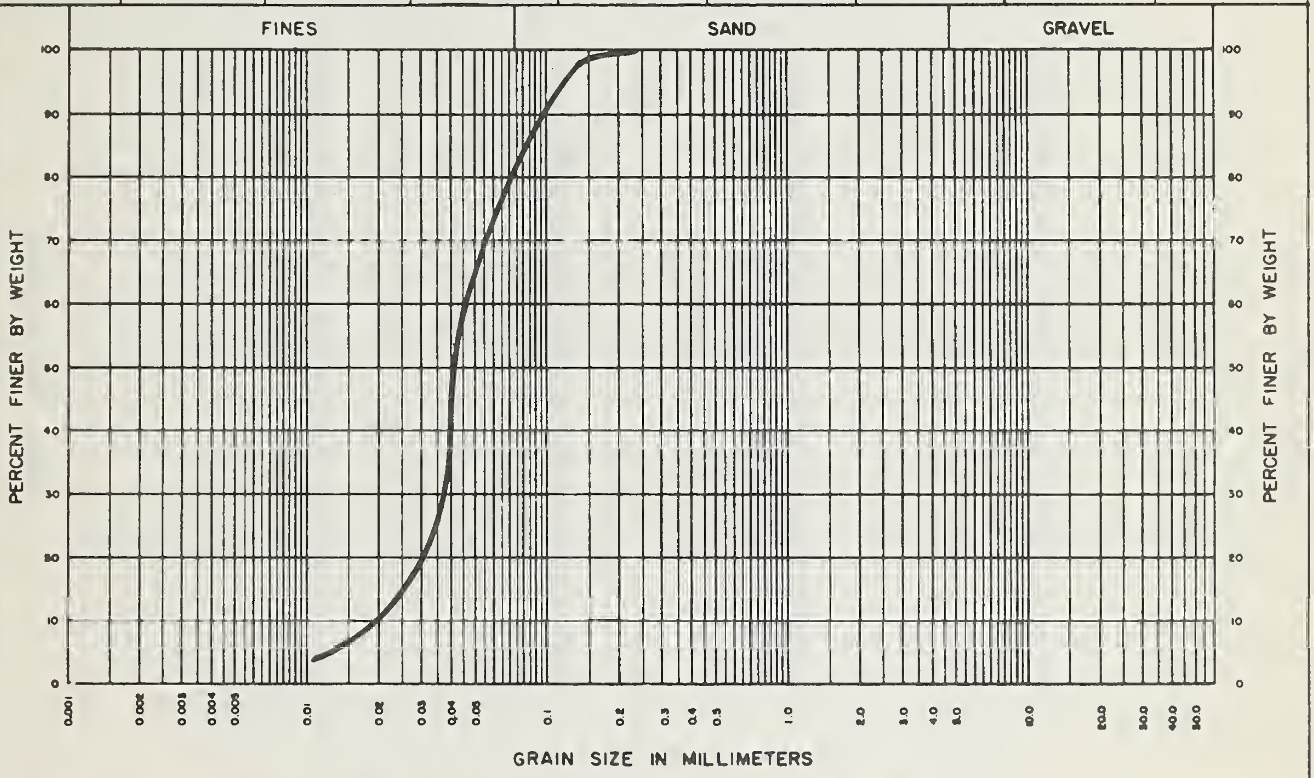
FIELD SAMPLE No.	TYPE of SAMPLE	ORIGIN
13	Bag	SOIL NEAR TILE Site 1 0 + 40 Tile line A

PROPOSED USE	TESTING SECTION SAMPLE No.	SUBMITTED BY
Tile drain evaluation	590226	Tuttle

1: SYMBOL	2: DESCRIPTION
	Gray sandy silt Puyallup silt loam

3: GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
0.02	0.025	0.036	0.040	0.045	0.080	0.250	--	--



4: SPECIFIC GRAVITY	5: ATTERBERG LIMITS						6: TOTAL SALTS	7: UNDISTURBED CONDITION	
	UNDISTURBED		AIR DRY		OVEN DRY			MOISTURE	UNIT WEIGHT
G	LL	LL	PI	PI	LL	PI			
2.82	--	--	--	--	--	--	-- %	--- %	-- lb/ft³

8: REMARKS

pH = 6.4

Non plastic (indicated by field identification test).

Tile siltation 3/4" deep.

U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING and WATERSHED PLANNING UNIT PORTLAND, OREGON	SIGNATURE JC Stevenson	
	TITLE Civil Engineer	DATE 12/19/58

MATERIALS TESTING SECTION REPORT	EWP-5 (10-20-56) Portland, Oregon	SOIL CLASSIFICATION

PROJECT	LOCATION
Tile Drain Evaluation	Skagit County, Washington — Arnold Wold

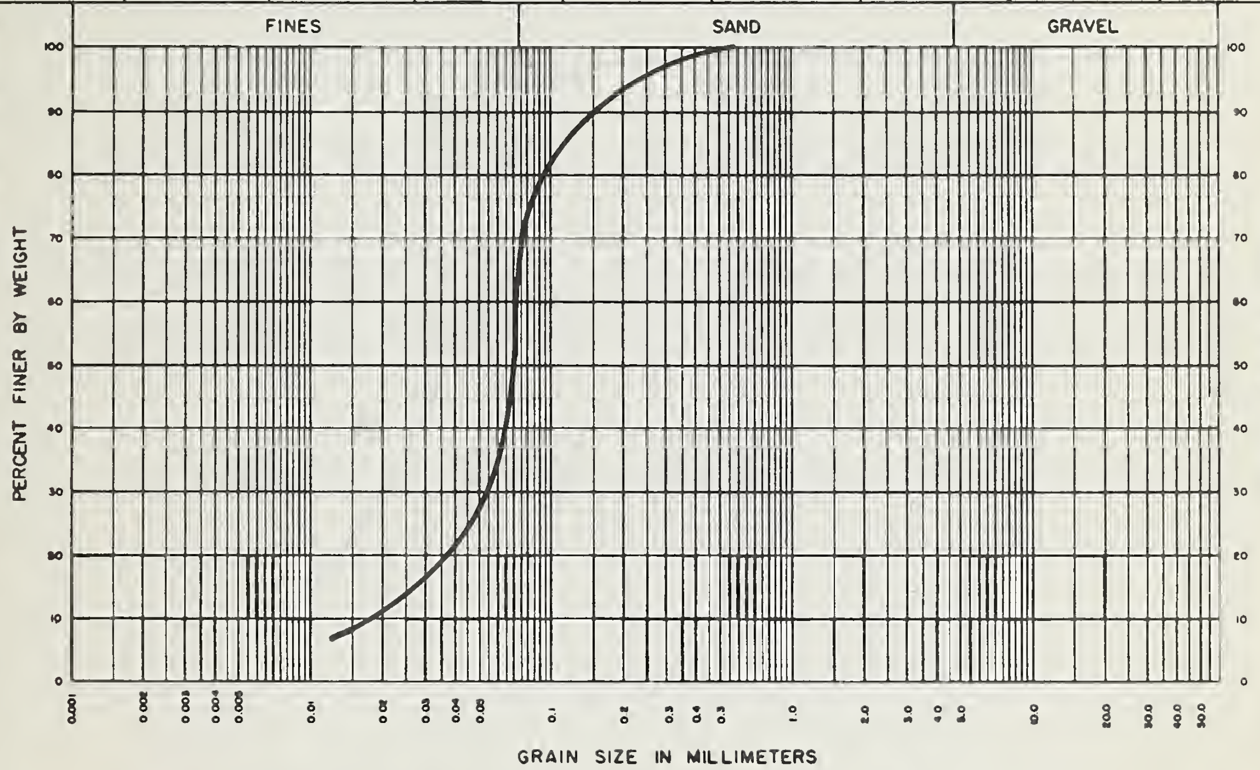
FIELD SAMPLE No.	TYPE of SAMPLE	ORIGIN
14	Bag	DEPOSIT IN TILE — Tile line A, Site 1 0 + 40

PROPOSED USE	TESTING SECTION SAMPLE No.	SUBMITTED BY
Tile drain evaluation	590227	Tuttle

1: SYMBOL	2: DESCRIPTION
	Dark brown sandy silt Surrounding soil is: Puyallup silt loam

3: GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c
0.018	0.027	0.05	0.07	0.074	0.12	0.9	--	--



4: SPECIFIC GRAVITY	5: ATTERBERG LIMITS						6: TOTAL SALTS	7: UNDISTURBED CONDITION	
	UNDISTURBED		AIR DRY		OVEN DRY			MOISTURE	UNIT WEIGHT
G	LL	PI	LL	PI	LL	PI			
--	--	--	--	--	--	--	-- %	-- %	-- lb/ft³

8: REMARKS

pH + 6.1

Non plastic (indicated from field identification test).

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING and WATERSHED PLANNING UNIT
PORTLAND, OREGON

SIGNATURE	
J C Stevenson	
TITLE	DATE
Civil Engineer	12/19/58

FIGURE 8

MATERIALS TESTING SECTION REPORT	EWP- 5 (10-20-56) Portland, Oregon	SOIL CLASSIFICATION

PROJECT	LOCATION
Tile Drain Evaluation	Skagit County, Washington — Arnold Wold

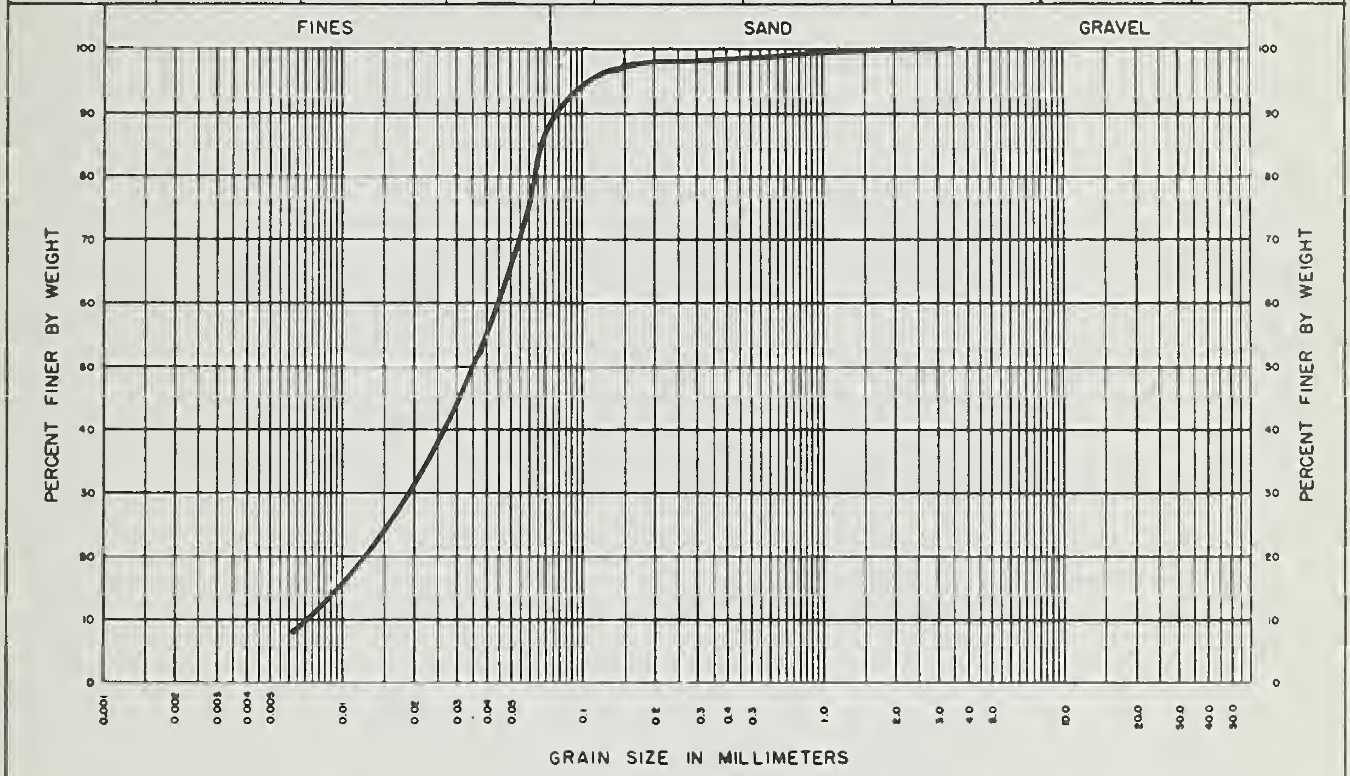
FIELD SAMPLE No.	TYPE of SAMPLE	ORIGIN
15	Bag	BACKFILL — Farm Site 2, Tile line A, 5 + 00

PROPOSED USE	TESTING SECTION SAMPLE No.	SUBMITTED BY
Tile drain evaluation	590228	Tuttle

1: SYMBOL	2: DESCRIPTION
	Light gray silt — Puget fine sandy loam

3: GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
0.007	0.0095	0.020	0.036	0.046	0.069	3.50	--	--



4: SPECIFIC GRAVITY	5: ATTERBERG LIMITS						6: TOTAL SALTS	7: UNDISTURBED CONDITION	
	UNDISTURBED		AIR DRY		OVEN DRY			MOISTURE	UNIT WEIGHT
G	LL	PI	LL	PI	LL	PI			
--	--	--	--	--	--	--	-- %	-- %	-- lb/ft³

8: REMARKS

pH = 6.4

Non plastic (indicated by field identification test).

U. S. DEPARTMENT of AGRICULTURE **SOIL CONSERVATION SERVICE** ENGINEERING and WATERSHED PLANNING UNIT PORTLAND, OREGON	SIGNATURE: J C Stevenson	
	TITLE: Civil Engineer	DATE: 12/19/58